Laparoscopic Billroth II Gastrectomy

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The first successful totally intra-abdominal laparoscopic Billroth II gastrectomy was performed on February 10, 1992, by our group (4) in Singapore. The patient was a 76-year-old Chinese man with a 2-year history of gastric ulcer, which presented with bleeding. The operation took 4 hours and consumed 17 ENDO GIA* (Auto Suture, USSC, Norwalk, CT) staplers. The benefits of this minimally invasive approach were clearly evident. The patient was walking on the first postoperative day, taking liquids on the third, solids on the fourth, and was discharged on the fourth postoperative day. The operation was subsequently emulated by surgeons in about a dozen countries. The description in this chapter is a modification of the original technique, using the improved instrumentation that is now available.

Indications

The indications for surgery are as follows:

1. Resistant or recurrent ulcer disease after a suitable course of medical treatment (3 months).
2. Bleeding gastric ulcer which is resistant or recurs after endoscopic haemostasis.
3. Perforated ulcer with minimal soilage.
4. Early gastric cancer or palliative resection in advanced carcinoma.

Our experience of Laparoscopic Billroth II gastrectomy in eighteen cases has been limited to distal gastric ulcers (at the incisura or beyond) in association with the first three above named indications. We believe that the role of laparoscopic resection in gastric carcinoma should be limited to palliation in advanced disease for now; however, R2 lymph node dissection, although time consuming, is probably possible via the laparoscope, particularly with improved instrumentation such as the laparoscopic ultrasound dissector and ultrasonic shears (UltraCision Inc, Smithfield, RI 02917).

Contraindications

The only absolute contraindication is a patient who is unfit for general anesthesia. A past history of upper-abdominal surgery is not a contraindication in

itself. In these circumstances, pneumoperitoneum can be achieved safely by employing an open technique, and if necessary, adhesiolysis. A history of past gastric surgery may render the anatomy difficult to discern and make the laparoscopic approach unsafe.

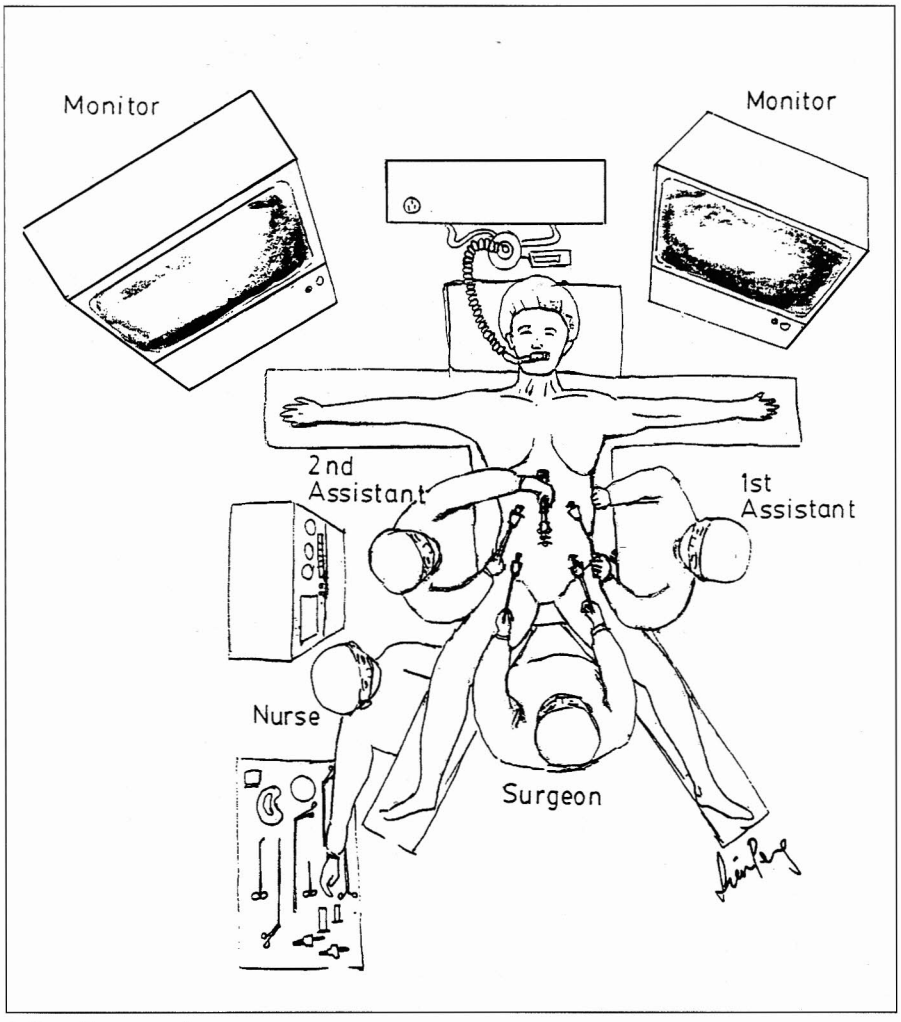
Pre-operative diagnosis and investigation

The patient should have upper GI endoscopy and the ulcer should be biopsied. Standard pre-operative work-up (i.e., hematology, electrolytes, coagulation, electrocardiogram and chest X-ray) is all that is required. Other investigations are ordered only if there are concomitant medical problems. Blood should be matched and available. The stomach should be washed out if pyloric stenosis is present. This latter step is particularly important as it is much more difficult to guard against gastric contamination of the peritoneum during the laparoscopic approach.

INTRAOPERATIVE MANAGEMENT AND SURGICAL TECHNIQUE

Operating theater set-up and anesthesia

The patient is operated in the supine position with legs apart and in the same plane as the rest of the body. A 20-degree, head-up tilt is applied. Surgery is done under general anesthesia with endotracheal intubation. End-tidal CO2 is monitored. The patient has a nasogastric tube P and urinary catheter. Antibiotic prophylaxis, a single dose of third generation cephalosporin, is given intravenously at the time of induction. The operating room set-up is as shown in Figure 1. The operator stands between the patient's legs, and two assistants stand on either side of the patient. The cameraman stands on the surgeons right and two television monitors are used, both placed obliquely over the patient's shoulders.



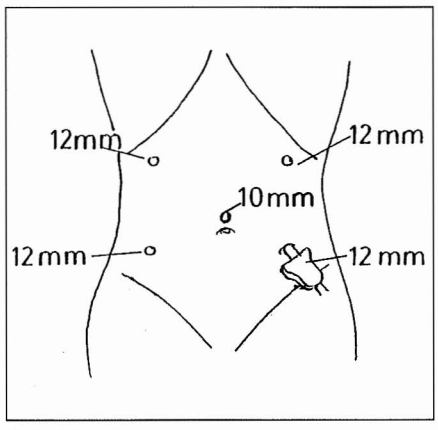
1. Operating room set-up.

Surgical Technique

- Port placement
- Five ports are placed in the positions shown in Figure 2.
- All ports are 12 mm except the central camera port which is 10 mm.

Mobilization of the greater curve of the stomach

A diagnostic laparoscopy is performed and the diagnosis confirmed. In some circumstances the site of the gastric ulcer is not seen at laparoscopy, and so an on-table gastroscopy is performed. This step also has the advantage of confirming the place of the pylorus—should the external surface marking the vein of Mayo not be immediately obvious. The greater curve of the stomach is then picked up with two EndoBabcock (USSC, Norwalk, CT) forceps, stretched out and lifted anteriorly. The individual branches of the epiploic vessels supplying the greater curve are then identified, skeletonized, clipped, and transected. This process can be greatly simplified by the use of the ultrasonic shears which allow the transection and simultaneous sealing of all but the most major vessels (UltraCision Inc, Smithfield, RI 02917). In thinner individuals with less fat in the greater omentum, it is possible to perform the dissection outside the epiploic arcade making use of avascular planes (Figure 3). It is then necessary to cut in towards the stomach only at the site selected for resection. The dissection is carried proximally about two-thirds up the greater curve and down distally to the pylorus. In fat individuals, it is more convenient to take down the epiploic attachments just next to the greater curve of the stomach wall.



2. Port Positions.

Dissection of the duodenum

The first part of the duodenum must be mobilized adequately to provide space for a safe transection with the EndoGIA stapler. Small vessels at the inferior and posterior surfaces of the first part of duodenum are connected to the pancreas and must be carefully controlled with diathermy or small clips and transected precisely without tearing. The superior angle of the duodenum can be identified by dissecting through a clear window of lesser omentum and creating a defect through it with endoshears and diathermy. Once this is done, a stapler can be positioned to traverse the entire width of the duodenum.

Transecting the duodenum

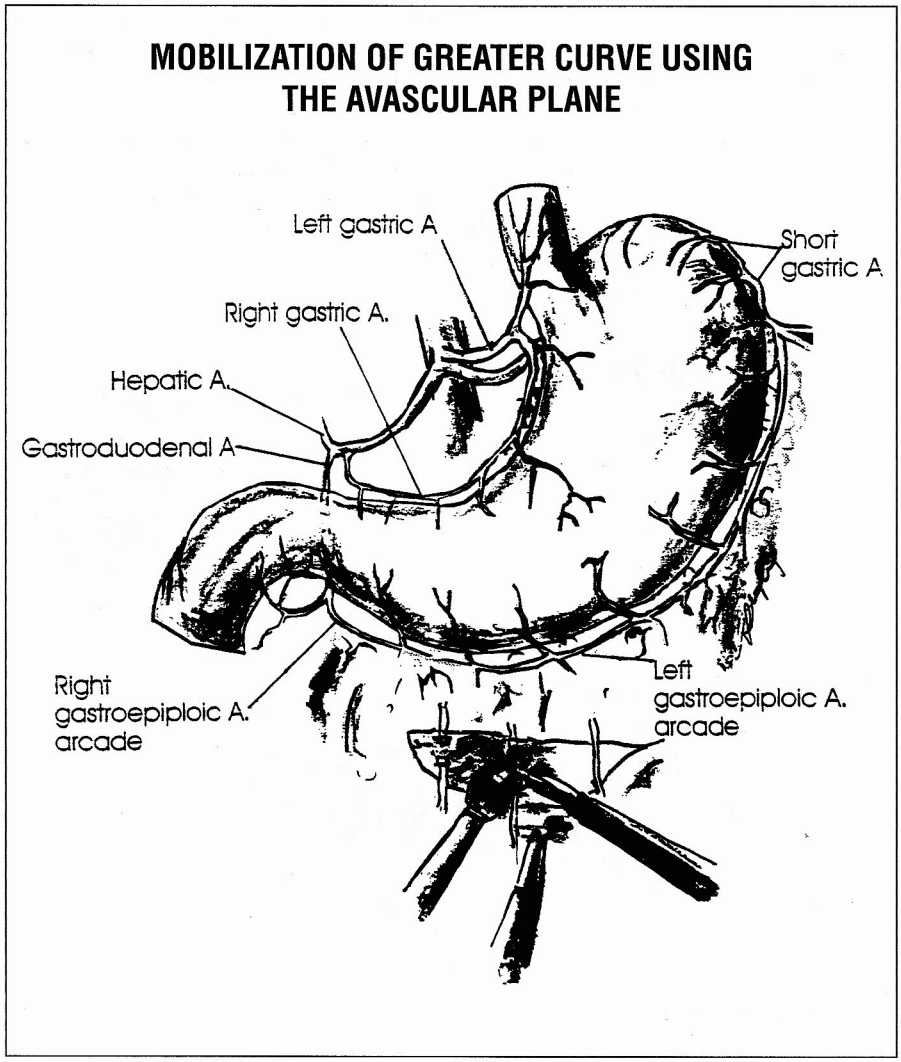
To transect the duodenum safely, the EndoGIA 30 stapler is positioned transversely across the duodenum so that both blades of the stapler protrude beyond the superior border of the D1. An EndoBabcock forceps is used to pull the duodenum against the hilt of the stapler jaws. Usually one application is adequate but some broad duodenums require two applications for complete transection (Figure 4).

Mobilization of the lesser curve

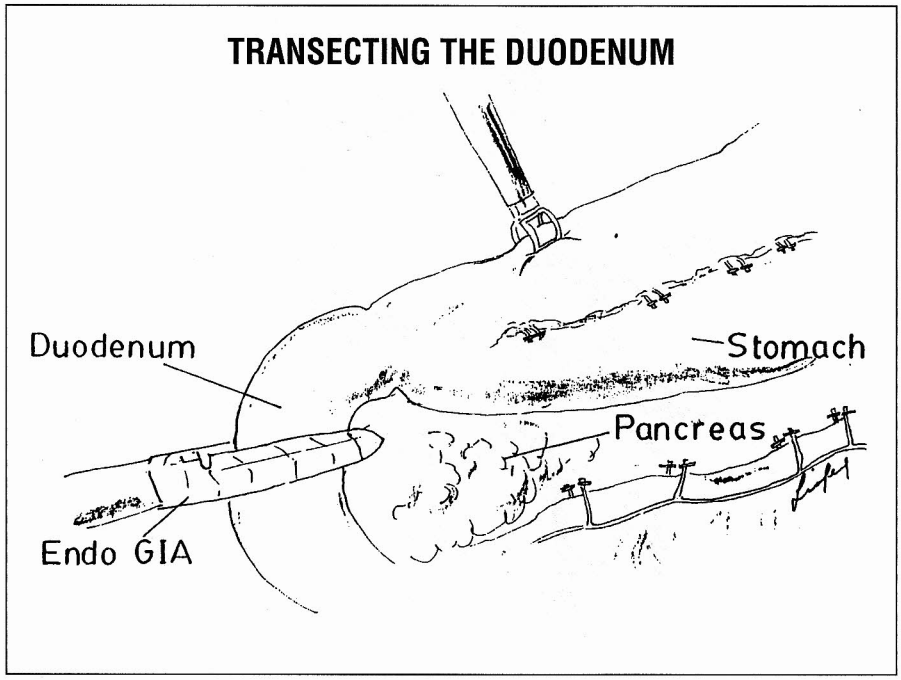
The ulcer usually causes an area of thick inflammatory tissue adjacent to it in the lesser omentum. This area is avoided and the lesser omentum is dissected through the less vascular areas closer to the liver. More proximally, it is necessary to transect the descending branches of the left gastric vessels. This thick bundle is best dealt with by transecting en masse with the vascular EndoGIA 30 at the point adjacent to the level of gastric resection along the lesser curve.

Transecting the stomach

The line of transection on the anterior surface of the stomach is marked with diathermy. The resection line leaves about one-third of the stomach behind. Actual cutting of the stomach is done with the EndoGIA stapler and proceeds with multiple applications from greater curve to lesser curve along the transection line marked out by diathermy. The 30-mm or 60-mm stapler can be used. The former is more ergonomic and easier to position, but requires three or four applications to transect the stomach. The stapler is inserted via a 12-mm port in the left upper quadrant. This

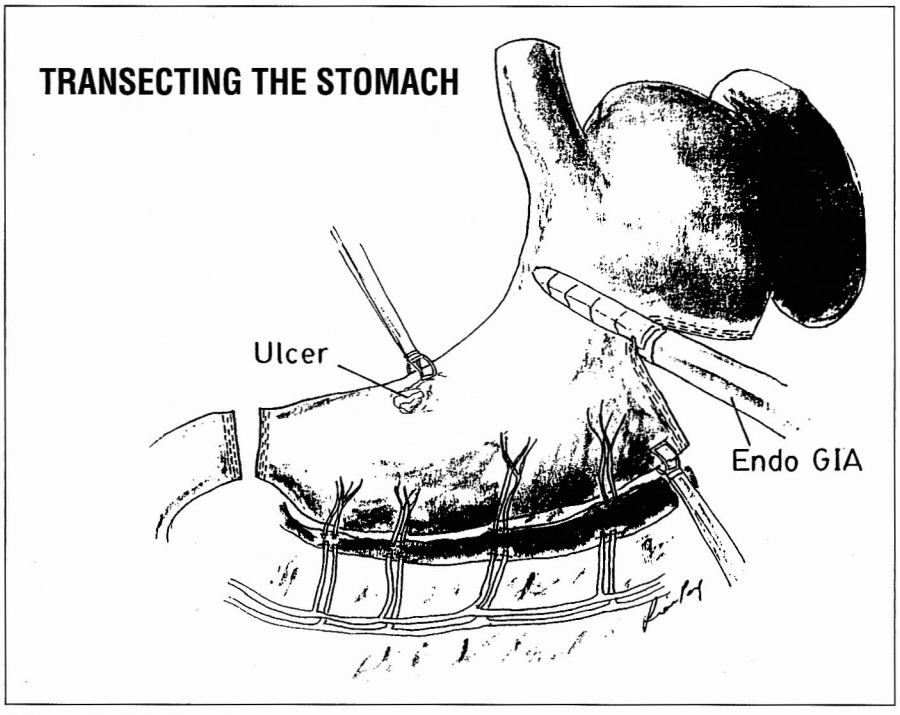


3. Mobilization of Greater Curve.

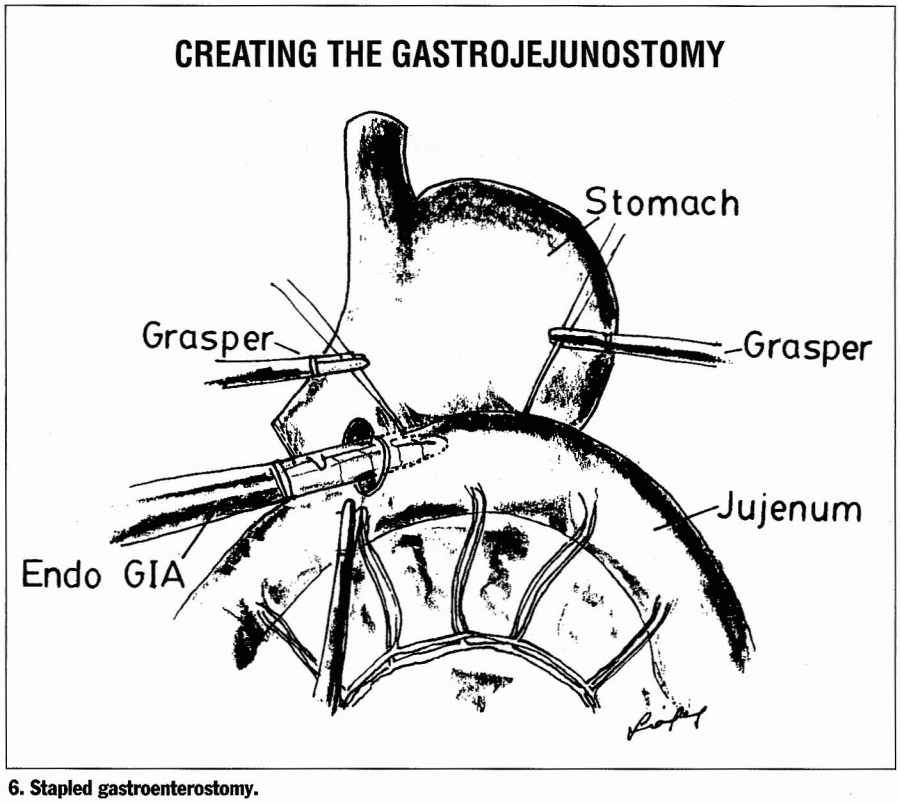


4. Transecting the Duodenum.

port gives the best angle for application of the stapler. If the 60-mm stapler is used, it usually has to be inserted in the left lower quadrant using a 12-mm port. This does not give a satisfactory angle, and there is a tendency to make the resection line too vertical, resulting in a narrowing of the stomach inlet. If the 60-mm stapler is inserted via the upper left port, it may be difficult to open it, as the distance from the abdominal wall to the greater curve of the stomach is too short to allow its opening. When making multiple applications of the stapler, subsequent applications are made exactly at the apex of the "V" of the previous staple line (Figure 5). Once the distal stomach is transected, it is placed on top of the right lobe of the liver and only removed after the gastrojejunostomy is complete.



5. Transecting the Stomach.



6. Stapled gastroenterostomy.

Constructing the gastrojejunostomy

The first step is to identify the duodeno-jejunal (DJ) flexure. This is most easily achieved with the patient in the head-down position and by then sweeping with a blunt forceps the transverse colon cephalad and anteriorly. A loop of small bowel is selected in the upper left quadrant and followed proximally, using atraumatic bowel clamps, to the junction of the duodenum and jejunum. After establishing the position of the DJ flexure, the jejunum is traced down to a point approximately 35–45 cm from the DJ flexure and a 20-cm segment is selected. The patient is then placed in the head-up position, and the selected segment of small bowel gently manipulated in front of, and above, the transverse colon, and is brought to lie along the inferior margin of the greater curve of the stomach. The anastomosis may be either iso- or anti-peristaltic; however, we feel that by positioning the gastroenterostomy so that the afferent loop is on the lesser curve side of the stomach (efferent loop on greater curve side), the likelihood of significant narrowing of the efferent limb of the anastomosis is reduced (see peri-operative complications). Thus, we prefer the anti-peristaltic arrangement for this technique. The jejunum is initially held in position with an EndoBabcock and then fixed using an intracorporeal technique of knot tying, with two 3-0 polyglactin (vicryl; Ethicon) sutures, one at either end of the proposed gastroenterostomy, fixing the antimesenteric aspect of jejunum to the anterior surface of the stomach stump. The suture ends are left long and thus can be used for retraction.

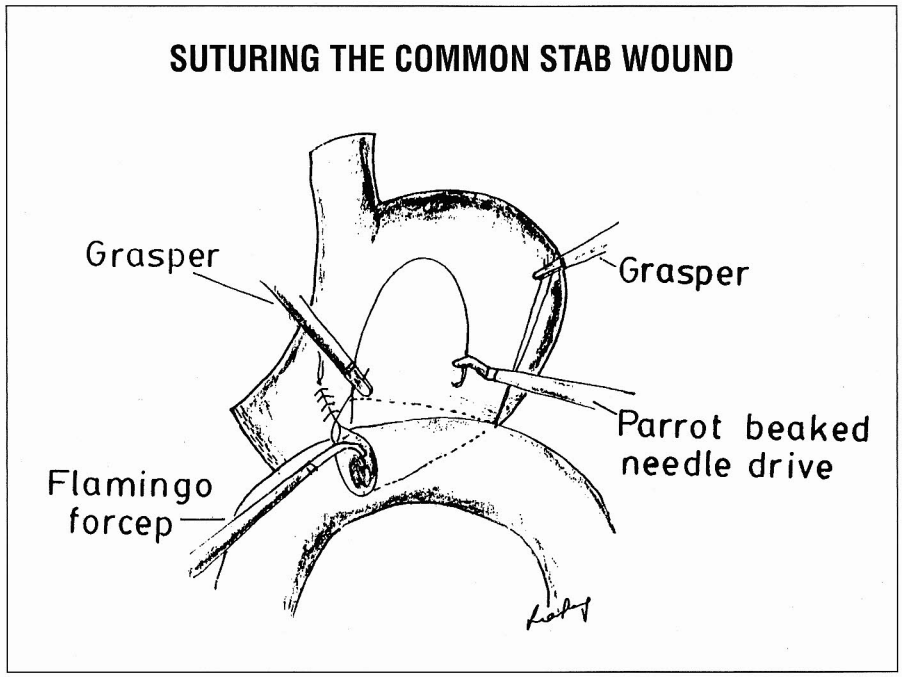
Stapled anastomoses

The surgeon approaches from the patient's right to allow easy insertion of the stapling device while the cameraman moves between the patient's legs and the first assistant remains on the patient's left. The stapled anastomosis is begun by creating two stab incisions using the diathermy endoshears (USSC, Norwalk, CT), one on the stomach and the jejunum, and on the right side of the proposed anastomotic line. The two incisions must be made adjacent to one another. While maintaining traction on the stays, the jaws of an Endo-GIA 30 lin-

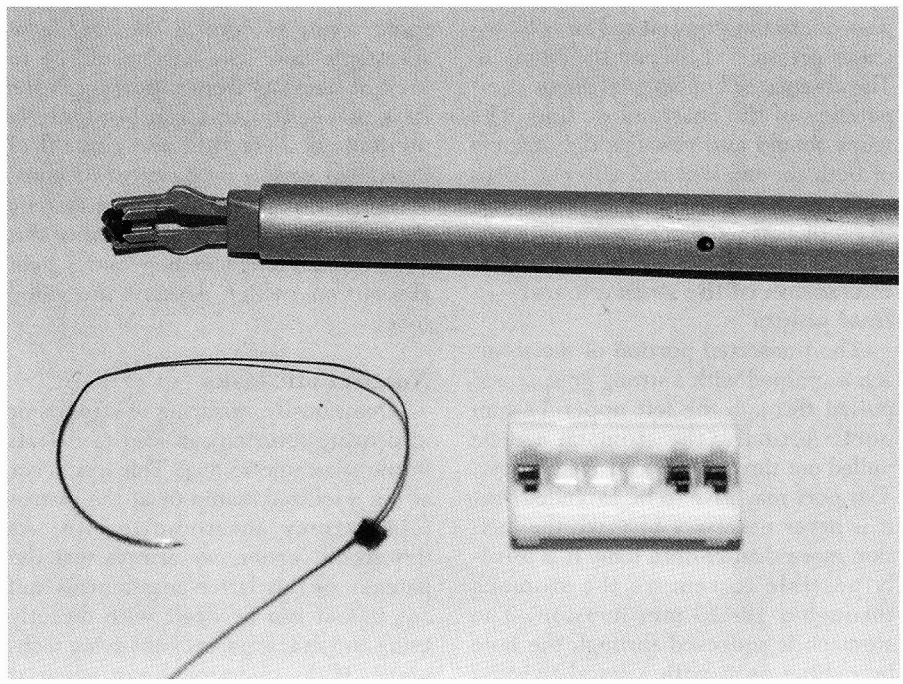
ear cutter and stapler (US Surgical, Norwalk, CT) are inserted, via the 12-mm right hypochondrial port, into the formed enterotomies. The Endo-GIA is inserted in the direction, lesser curve to greater curve of the stomach, and has one jaw within the stomach and the other within the jejunum. The jaws should be closed and, after checking that the posterior and inferior surfaces are free, they should be fired (Figure 6). It is not always easy to place the stapler jaws into the enterotomies, and this step can be facilitated by the placement of a further stay suture, which joins the bottom of the two holes and keeps them close together. A second firing of the GIA, at the apex of the newly created gastroenterostomy, results in an anastomosis of approximately 6 cm in length as long as adequate tension is maintained on the lateral stay suture at the time of firing. During this step it is important to pull the stab wound margins against the hilt of the stapler to maximize the anastomotic length. Although the single firing of a 60-mm stapler to create the enterostomy would seem logical, there are practical problems associated with inserting the larger 60-mm stapler through a left upper quadrant port. There may be difficulty in opening the stapler, as the distance from the abdominal wall to the greater curve of the stomach is too short to allow the complete opening of the stapler itself. Insertion of the 60-mm stapler through a left lower quadrant port has been used; however, the resulting angle tends to produce a more vertical anastomotic line than is ideal, and there is a risk of narrowing or kinking one of the loops. At this stage, Mouiel et. al.[5] inspected the gut lumen and stapled edges for bleeding using a side-viewing laparoscope. The resulting enterotomies can be closed using a continuous 2-0 vicryl suture on a 30-mm needle mounted on a 5-mm endoscopic needle holder, in two layers, or by using the Endo-GIA and two stay sutures to hold the defect in apposition and, then, position it optimally for staple closure. It is important to staple or suture this defect transversely to create a "plasty" effect in order to prevent the narrowing that would occur by simple longitudinal opposition (Figure 7). It is equally important to pick up as little excess tissue as possible in stapling this defect and hand suture, although a slower technique, picks up less tissue and is not as likely to result in narrowing, particularly if a single layer technique is employed. Because of the position of the common stab wound, any narrowing resulting from its closure is likely to affect the afferent limb only, and to be of less significance. Hence our preference for the "anti-peristaltic" gastroenterostomy with the technique described.

Hand-sutured anastomosis

Although a less convenient and more time-consuming alternative, a hand-sutured an anastomosis is significantly cheaper. We perform a "continuous" two-layered sutured gastrojejunostomy using the Szabo-Berci "parrot" beaked needle and "flamingo" beaked knotting forceps (Karl Storz Endoscopy America, Inc.). The initial step is the placement of two vicryl stay sutures at either end of the proposed gastroenterostomy. A continuous posterior seromuscular layer is then fashioned after which the full-length gastrotomy and enterotomy are created using a combination of hook and endoshears on coagulative diathermy. Bleeding from the gastrotomy is usually worse than that from the enterotomy and it is therefore



7. Suture of common stab wound.



8. Endoscopic absorbable clip and clip applicator (LAPRA TY, Absorbable suture clips, Ethicon).

important to carefully create diathermy in the serosal stomach wall at the proposed site of enterostomy prior to gastrotomy, and to precisely pick up tiny bleeding points with fine forceps. The right iliac fossa and right hypochondrial ports are used for the stitching instruments. While the first assistant is between the patient's legs, the surgeon is placed on the patient's right and follows the thread using a grasping forceps passed through the left iliac fossa port. The posterior full-thickness sutureline is then completed, followed by the anterior full-thickness layer and finally the anterior outer seromuscular layer. In each case it is ergonomically easier to suture towards oneself. Four separate sutures are used (3-0 vicryl). The time-consuming process of laparoscopic knotting[7,8,9] may be obviated by using absorbable suture clips (LAPRA, TY,Ethicon) (Figure 8). One clip is used to hold the proximal starting end of a continuous suture, and the suture line is secured with a second clip at the end. The clips are specially designed to hold sutures securely, and no knots are required using this technique. A new stitching device called the Endostitch (USSC, Norwalk, CT) seems promising in swift completion of this continuous suture line.

Checking the anastomosis

The anastomosis must be checked endoscopically for leakage as well as patency. The patient is tilted head-down about 20 degrees. The anastomosis is flooded with saline. A gastroscope is passed into the stomach and air is blown under pressure to distend the stomach. The absence of bubbling confirms competency of the anastomotic line. The scope should also visualize the opening of both the efferent and afferent loops of the jejunal anastomosis. It is possible to gently pass the scope into both loops.

Extraction of the stomach and final points

The transected portion of the stomach is grasped with a strong grasper and pulled through the left upper 12-mm port. Actually, the stomach can be pulled out through any convenient port. This port may have to be extended, but it is never necessary to make the incision more than 25-mm long. It is usually possible to remove the stomach through a 18–20 mm incision. The stomach is squeezed through the hole by pulling on it with a spiral twisting motion. In two of our patients, subsequent histological analysis of the resected specimen has shown an unexpected early gastric cancer. In view of this, we have modified our extraction technique to include insertion of the specimen into a bag, prior to removal from the abdominal cavity, to reduce any risk of seedling implantation. The fluid is aspirated from the abdomen and the stab wounds in the abdominal wall closed in two layers taking care to suture the fascia securely to prevent hernia formation. The wounds are infiltrated with long acting anesthetic (Bupivicaine) to give immediate postoperative pain relief. Infiltrating the anesthetic periperitoneally under laparoscopic vision makes a difference in the postoperative pain profile. This was observed in a recently conducted, randomized controlled trial in our department.

COMMON PERIOPERATIVE PROBLEMS

Bleeding

This can be caused by the wrong choice of planes or the inappropriate use of the vascular EndoGIA stapler. When mobilizing the greater and lesser curve, it is best to choose avascular planes away from the stomach edge rather than dissecting close to the stomach where there are more vessels. It is only necessary to dissect close to the stomach at the line of transection. It is tempting to use the EndoGIA to take out large sections of mesentery, but these staplers often aren't adequately haemostatic and much time is then spent trying to control bleeding from the staple line. The best would be to prevent bleeding from occurring in the first place, and this can be done by meticulous dissection and control of individual vessels by ligatures or clips, although the advent of the ultrasonic shears (UltraCision) may simplify this step. In addition, bleeding causes light absorption, which darkens the video tube.

Anastomotic leaks

Occasionally, misfiring of staplers or inadequate suturing can lead to defects in the anastomotic line. This can occur at the duodenal stump or at the gastrojejunostomy anastomotic site. As described earlier, we always test the patency of this latter anastomosis and any defect can be dealt with directly using an intracorporeal knot-tying technique. If the operator is not adept at this technique, the defect can usually be sutured through a small incision using conventional open surgical techniques.

Narrowing of the gastrojejunal anastomosis

When closing the common stab wound of the gastrojejunostomy with staplers, it is possible to narrow either the afferent or efferent orifice of the anastomosis. This can be recognized at gastroscopy. The solution is to construct an enteroenterostomy just below the anastomosis. This can be done with the EndoGIA or with hand-sutured anastomosis laparoscopically. A quicker but more invasive technique would be to make a small incision exposing the anastomosis site under laparoscopic guidance and construct the enteroenterostomy by open surgical techniques with either staplers or sutures.

Problems encountered in transecting the stomach

The line of transection of the stomach must be marked out carefully so as not to compromise the inlet of the stomach or block off the esophago gastric junction. This is quite an easy mistake to make, especially if the 60-mm endostaplers are used. These staplers give little room for error, because they need to be protruded fairly deeply inside the abdomen before they can be opened, it may be necessary to use them through the left lower quadrant port. When using this port, the angle of stomach transection is fairly vertical and one may transect higher up on the lesser curve than one realizes—thus compromising the oesophageal lumen. The 30-mm staplers can be used through the upper left port giving a more horizontal and safer transection line. Furthermore, as each cut is only 30 mm, there is a margin for error and the operator can shift the angle of resection either up or down quite freely and adjust the transection line accordingly.

Malignancy in the ulcer

Where an unexpected area of malignancy is discovered in the ulcer, after the resection, the surgeon is faced with a difficult problem. The best solution may lie in subsequent completion lymphadenectomy at open surgery to give the patient the best chance for cure; however, the data resulting from the Japanese experience with local resection for early gastric cancer may reduce the need for subsequent surgery

depending on the precise histological findings.

DISCUSSION

Early experience with this operation has shown that there are certain important advantages to this approach. First, the postoperative recovery is phenomenal. Certainly, it holds the promise of less pain, less immobility, quicker alimentation, shorter hospitalization, less wound and respiratory complications, and an earlier return to normal activities. Our best patients are walking around on the first postoperative day, drinking on the third, eating on the fourth, and in some cases, are even going home on the fifth. It is the older patients who really benefit, with a reduction in morbidity.[9] The main drawback of this procedure is the cost of the endoscopic stapling devices. This is being overcome in many imaginative ways. One surgeon in China is able to modify existing staplers to fire about 10 times! The ultimate solution of course is the development of a laparoscopic suturing technique. Although still not surgeon-friendly, new equipment makes the prospect at least worth considering. Almost all the anastomosis can be hand-sutured if one is experienced enough. At present, most operators are using a combination of stapling and suturing. In our 18 cases, 16 were performed for gastric ulcers, 1 was a combination gastric and duodenal ulcers, and 1 was gastric volvulus. The time taken for the procedure is fairly long but well compensated for by the quicker recovery and shorter hospitalization. Our fastest time was 2 hours 30 minutes but operations have been known to go on for 5 hours or more. The operating time, however, steadily decreases with greater experience. STI

REFERENCES

1. Melotti G, Bonilauri S, Tanaborrino E, Selmi I. Laparoscopic
gastric resection. Surgical Endoscopy 1994; 8(5):434.
2. Takifuji K, Tanimura H, Nagai Y, Kashiwagi H, Nakatani Y. Laparoscopic assisted distal gastrectomy with Billroth I anastomosis. Surgical Endoscopy 1994; 8(5):434.
3. Kitano S, Yasunori I, Moriyama M, Sugimachi K. Laparoscopic Billroth I gastrectomy. Surgical Laparoscopy & Endoscopy 1994; 4(2):146–148. Resecktion des Carinomatosen Pylorus. Wein Med Wochenschr 1991; 31:1427.
4. Goh PMY, Tekant Y, Kum CK, Isaac J, Ngoi SS. Totally intra-abdominal laparoscopic Billroth II gastrectomy. Surg Endos 1992;6:160.
5. Mouiel J, Kathouda N, White S, Dumas R. Endolaparoscopic palliation of pancreatic cancer. Surg Lap & Endo 1992; 2(3): 241–243.
6. Szabo Z, Extra and intracorporeal knotting and suturing techniques. In: Berci G (ed); GI Endoscopy Clinics of North America, Philadelphia, WB Saunders, 1993; 367-379.
7. Szabo Z, Henderson SR: Organizing training programs in laparoscopic microsurgery: set-up, curruculum, and standards. In: Endoscopy in Gynecology, AAGL 20th Annual Meeting Proceedings; American Association of Gynecologic Laparoscopists, Sante Fe Springs, 1993; 259-265.
8. Szabo Z; Laparoscopic suturing and tissue approximation. In: Hunter JG, Sackier JM (eds): Min Invas Surg, McGraw-Hill, 1993: 212-231.
9. Goh P, Kum CK. Laparoscopic Billroth II Gastrectomy: a review. Surgical Oncology 1993; 2:Supplement 1, 13–18.

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